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## ORIGINAL ARTICLES: VARIOUS TOPICS

# Measuring Progress in Meeting Healthy People Goals for Low Birth Weight and Infant Mortality among the 100 Largest Cities and Their Suburbs

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**ABSTRACT** *We examined the progress of the nation's 100 largest cities and their surrounding suburban areas toward achieving Healthy People 2000/2010 goals for two measures of infant health: low birth weight (LBW) and infant mortality (IM). Using data from the National Center for Health Statistics, we compared 1990 and 2000 urban and suburban LBW and IM rates to target rates for Healthy People 2000 and 2010 objectives. Although the 2000 LBW weight rate for the 100 largest cities was higher than the average for the suburbs (8.9% vs. 7.1%), the increase in LBW rates for the suburbs was nearly four times that of the cities (15.7% vs. 4.1%). Suburban and urban white infants led the increases in LBW rates; urban and suburban black infants showed a slight decrease or no change in LBW rates. Neither cities nor suburbs, on average, met the 2000 target rate of 5%. It appears unlikely that most of the 100 largest cities and suburbs will meet the Healthy People 2010 goal, which remains at 5%, without reductions in preterm births, nationally on the rise. The IM rate declined across most cities and suburbs between 1990 and 2000. However, the 100 largest cities on average did not meet the 2000 IM rate target of 7 infant deaths per 1000 live births; their suburbs did (8.5 vs. 6.4, respectively). The cities and suburbs that did not meet the 2000 target may be especially challenged to meet the 2010 goal for IM unless rates of preterm births are reduced. With the continuing black–white disparities in LBW and IM rates and the overall differences in the racial composition of the largest cities and suburbs, strategies for meeting Healthy People goals will likely need to be targeted to the specific populations they serve.*

**KEYWORDS** *Healthy People goals, Infant mortality, Low birth weight, Suburban health, Urban health.*

## INTRODUCTION

In 1979, the Office of the Surgeon General, US Department of Health and Human Services, released the first Healthy People report on health promotion and disease prevention.[1] This initiative created a set of goals for achieving measurable health objectives in each major stage of life, from infancy to old age. A collaborative effort of federal agencies, state health departments, nonprofit organizations, and business and scientific groups continued this work. The result was creation of Healthy People 2000 and Healthy People 2010 goals, which centered on increasing the span

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of healthy life, reducing racial/ethnic and socioeconomic health disparities, and achieving access to preventive health care services.[2] Although useful as a barometer for the nation, one of the primary applications of Healthy People 2000/2010 goals is assisting state- and local-level decision makers in assessing and improving the health of residents in communities across the country. With 153 million Americans, or 53% of the US population, living in the 100 largest cities and their surrounding suburbs, measuring local progress on Healthy People objectives is critical to monitoring and improving the health of the nation as a whole.

In this study, we show the progress of the nation's 100 largest cities and their surrounding suburban areas toward achieving Healthy People 2000/2010 goals for two measures of infant health: low birth weight (LBW) and infant mortality (IM). They are key measures of a nation's overall health and well-being and serve as predictors of health status of the next generation. We compared 1990 and 2000 LBW and IM rates of the 100 largest cities and their suburbs to national rates and Healthy People 2000 and 2010 target rates. We also compared city and suburban rates by region of the country and examined LBW rates for cities and suburbs by race/ethnicity. In addition, we used 2000 data to consider how the relationship between LBW and IM varies for cities compared to the suburbs.

## METHODS

The Social and Health Landscape of Urban and Suburban America project documents the social and health improvements and challenges occurring in the nation's 100 largest cities and their suburbs between 1990 and 2000. The selection of the 100 largest cities for both 1990 and 2000 was based on population counts from the 2000 census.[3,4] For the 100 largest cities that are part of the same metropolitan statistical area (MSA) as defined by the Federal Office of Management and Budget (OMB) for Census 2000 (e.g., Minneapolis and St. Paul), the city data were combined to create a single urban area that could be compared with its surrounding suburban area. Thus, the 100 largest cities were combined into 82 distinct city cases. (Because Anchorage City, AK, and MSA boundaries are the same, there are only 81 suburban areas included in the analysis.) We defined the suburbs as the counties making up a primary MSA, excluding the central city or cities. Although there is no standard method for defining a suburban area, the counties are the federal government's standard building blocks for defining an MSA.[5] Suburban rates represent the sum of the data from all of the counties within an MSA less the data from the city divided by the sum of the appropriate population data for those counties less the population data from the city.

Data on LBW, IM, and birth counts were available for cities and metropolitan areas for 1990 and 2000 from the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC).[6,7] Although we selected the 100 largest cities based on the 2000 census, NCHS used OMB definitions of MSAs for the 1990 census for both 1990 and 2000 infant health data. The 1990 data were available for cities and MSAs with a population of 100,000 or more in 1980; 2000 data were available for cities and MSAs with a population of 100,000 or more in 1990. Complete data were available for IM and for all but 3 of the 100 largest cities—Plano, Texas, and Glendale and Scottsdale, Arizona—for LBW.

From the NCHS data sets, we calculated city and suburban LBW rates, defined as the percentage of live births with a birth weight less than 2,500 grams or 5.5 pounds; IM rates were defined as the number of deaths in the first year of life per

1,000 live births.[8] Tabulations for LBW rates excluded from the denominator of total births those cases for which information related to that outcome was missing. Caution must be used in the interpretation of IM rates, particularly at the city level. The CDC noted in its IM data file that the mother's place of residence may not always be accurately recorded on the birth certificate if it is different from the location of delivery.

We also examined birth data by race/ethnicity for cities and suburbs and report LBW rates for non-Hispanic whites, non-Hispanic blacks, Hispanics (who can be of any race), and Asians. The average rates excluded data from places that had fewer than 100 births in any racial/ethnic group. (The denominator for each group's average is as follows for cities: whites, n=82; blacks, n=81; Hispanics, n=76; Asians, n=69; and for suburbs: whites, n=80; blacks, n=65; Hispanics, n=70; Asians, n=60.) We did not report IM rates by race/ethnicity because many suburbs and some smaller cities had fewer than 20 infant deaths for blacks or Hispanics; the CDC considers lower numbers too small to report as a rate.

The average rates presented for cities and suburbs are the unweighted means of individual city or suburban rates. The percentage changes reported refer to the percentage change in the average rate for a set of cities or suburbs rather than an average of each cities' or suburbs' percentage change.

## RESULTS

### Low Birth Weight Trends in US Cities and Their Suburbs

For both 1990 and 2000, the average LBW rate for the 100 largest cities was well above the national average; the average suburban rate was below the national average (Fig. 1). LBW rates generally increased between 1990 and 2000 across the 100 largest cities and their suburbs. The increase for the suburbs, however, was nearly four times that of the cities (15.7% vs. 4.1%) on average. At rates of 8.9% and 7.1%, respectively, neither cities nor their suburbs achieved the 2000 Healthy People LBW target of 5%. The 2010 target[1] remains at 5%.

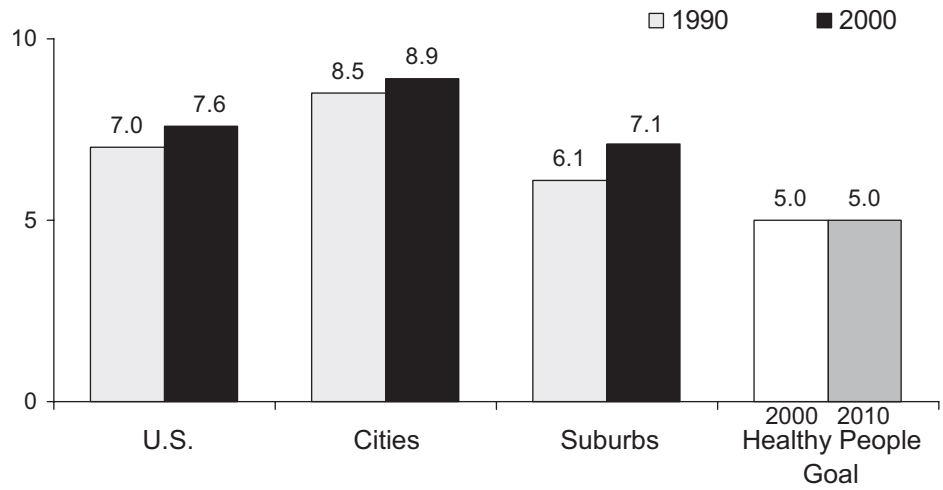


**FIGURE 1.** Percentage of live births of low birth weight.

**TABLE 1. Low birth weight and infant mortality rates for the 100 largest cities and their suburbs by region, 1990–2000**

| | Total (N = 82)* | Northeast (N = 8) | Midwest (N = 19) | South (N = 32) | West (N = 23)* |
|---|---|---|---|---|---|
| Low birth weight (% of live births) | | | | | |
| Cities | | | | | |
| 1990 | 8.5 | 10.2 | 8.7 | 9.2 | 6.7 |
| 2000 | 8.9 | 10.4 | 9.1 | 9.7 | 7.0 |
| % change | 4.1 | 2.0 | 4.6 | 4.9 | 3.2 |
| Suburbs | | | | | |
| 1990 | 6.1 | 5.9 | 5.4 | 6.9 | 5.8 |
| 2000 | 7.1 | 6.9 | 6.4 | 7.9 | 6.5 |
| % change | 15.7 | 17.2 | 19.3 | 13.3 | 12.9 |
| Infant mortality (per 1,000 live births) | | | | | |
| Cities | | | | | |
| 1990 | 11.1 | 13.8 | 12.3 | 11.5 | 8.5 |
| 2000 | 8.5 | 10.9 | 9.5 | 9.1 | 5.9 |
| % change | −23.4 | −20.7 | −23.1 | −20.6 | −30.7 |
| Suburbs | | | | | |
| 1990 | 8.1 | 7.2 | 7.1 | 9.0 | 8.0 |
| 2000 | 6.4 | 5.5 | 6.0 | 6.9 | 6.5 |
| % change | −20.5 | −23.1 | −14.8 | −23.8 | −18.4 |

*Source:* Tabulations based on data from the National Center for Health Statistics.

*Because Anchorage City, AK, and metropolitan statistical area boundaries are the same, the number of suburbs represented is 81 for the total and 22 for the West.

Although the gap between city and suburban LBW rates narrowed over the last decade, the divide is still considerable in all regions except the West, which came closest to meeting the Healthy People target, with an average city rate of 7%, and a suburban average of 6.5% (Table 1). The Northeast, with the highest city-to-suburban ratio of LBW rates, had the highest 2000 city average (10.4%) despite having the smallest average city increase of 2%. The Midwest and South experienced the largest average increases in city rates, both about 5%. The suburbs of the Midwest saw LBW rates rise by nearly one fifth (19.3%), on average, over the 1990s, followed by a substantial increase in the suburbs of the Northeast as well (17.2%). Both 1990 and 2000 suburban LBW rates were highest in the South on average.

Table 2 presents 1990 and 2000 LBW rates, ranked by the lowest 2000 rate, for the 100 largest cities and their suburbs. None of the 100 largest cities met the Healthy People 2000 LBW goal of 5% in either 1990 or 2000. Santa Ana/Anaheim, California, had the lowest urban LBW rate (5.5%) in 2000. Fourteen suburbs had met the 2000 LBW target in 1990, but by 2000, none were still meeting the goal. Although most cities saw their LBW rate increase between 1990 and 2000, a decrease in LBW rate was experienced by 23 cities, and another 4 saw no change. By contrast, only 6 suburbs saw their LBW rates decline over this period.

### City and Suburban Low Birth Weight Rates by Race/Ethnicity

A closer examination of LBW rates by race/ethnicity showed that the trend for blacks and Hispanics differed from that for whites, and the average rates within

**TABLE 2. 1990 and 2000 low birth weight rates for the 100 largest cities and their suburbs ranked by lowest 2000 rate (Healthy People 2000 and 2010 low birth rate goal 5.0%)**

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Santa Ana/Anaheim, CA | 5.4 | 5.5 | 1.9 | Spokane, WA | 3.2 | 5.3 | 65.6 |
| Madison, WI | 6.6 | 5.8 | –12.1 | Des Moines, IA | 6.1 | 5.4 | –11.5 |
| San Jose, CA | 5.7 | 5.9 | 3.5 | Santa Ana/Anaheim (Orange Co.), CA | 5.0 | 5.4 | 8.0 |
| Tacoma, WA | 6.4 | 6.1 | –4.7 | Seattle, WA | 4.9 | 5.4 | 10.2 |
| Anchorage, AK | 5.2 | 6.1 | 17.3 | Lincoln, NE | 3.7 | 5.4 | 45.9 |
| Seattle, WA | 6.6 | 6.3 | –4.5 | Portland, OR | 4.5 | 5.6 | 24.4 |
| San Diego, CA | 6.1 | 6.3 | 3.3 | Milwaukee, WI | 4.5 | 5.6 | 24.4 |
| Spokane, WA | 5.8 | 6.4 | 10.3 | Wichita, KS | 5.8 | 5.7 | –1.7 |
| San Francisco, CA | 6.7 | 6.5 | –3.0 | Rochester, NY | 5.2 | 5.7 | 9.6 |
| Los Angeles/Long Beach/ Glendale, CA | 6.5 | 6.6 | 1.5 | Minneapolis/ St. Paul, MN | 4.7 | 5.7 | 21.3 |
| Oakland/Fremont, CA | 7.7 | 6.7 | –13.0 | Stockton, CA | 4.4 | 5.7 | 29.5 |
| Riverside, CA | 6.3 | 6.7 | 6.3 | San Diego, CA | 5.3 | 5.8 | 9.4 |
| Stockton, CA | 7.1 | 6.8 | –4.2 | Fresno, CA | 5.3 | 5.8 | 9.4 |
| Portland, OR | 6.1 | 6.8 | 11.5 | Sacramento, CA | 5.1 | 5.8 | 13.7 |
| Austin, TX | 6.8 | 6.9 | 1.5 | Fort Wayne, IN | 4.2 | 5.8 | 38.1 |
| Bakersfield, CA | 6.8 | 6.9 | 1.5 | Bakersfield, CA | 6.4 | 6.0 | –6.3 |
| Lincoln, NE | 5.8 | 6.9 | 19.0 | San Francisco, CA | 5.1 | 6.1 | 19.6 |
| Fresno, CA | 7.0 | 7.0 | 0.0 | Tacoma, WA | 5.7 | 6.2 | 8.8 |
| Des Moines, IA | 6.7 | 7.0 | 4.5 | Los Angeles/Long Beach/Glendale, CA | 5.6 | 6.2 | 10.7 |
| El Paso, TX | 6.9 | 7.1 | 2.9 | Madison, WI | 4.8 | 6.2 | 29.2 |
| Phoenix/Mesa/Glendale/ Scottsdale, AZ† | 6.7 | 7.1 | 6.0 | Omaha, NE | 4.4 | 6.3 | 43.2 |
| Lexington, KY | 6.8 | 7.2 | 5.9 | Grand Rapids, MI | 4.4 | 6.3 | 43.2 |
| Sacramento, CA | 6.6 | 7.2 | 9.1 | Riverside, CA | 6.2 | 6.4 | 3.2 |
| Las Vegas, NV | 6.5 | 7.2 | 10.8 | Akron, OH | 5.6 | 6.4 | 14.3 |
| Fort Worth/Arlington, TX | 7.3 | 7.6 | 4.1 | Kansas City, MO | 6.3 | 6.5 | 3.2 |
| Houston, TX | 8.1 | 7.7 | –4.9 | San Antonio, TX | 6.0 | 6.6 | 10.0 |
| Minneapolis/ St. Paul, MN | 7.2 | 7.7 | 6.9 | Oakland/ Fremont, CA | 5.9 | 6.6 | 11.9 |
| San Antonio, TX | 6.9 | 7.7 | 11.6 | Houston, TX | 5.8 | 6.6 | 13.8 |
| Albuquerque, NM | 8.2 | 7.8 | –4.9 | Indianapolis, IN | 5.6 | 6.6 | 17.9 |
| Wichita, KS | 7.0 | 7.9 | 12.9 | Toledo, OH | 5.6 | 6.6 | 17.9 |
| Honolulu, HI | 6.8 | 7.9 | 16.2 | Austin, TX | 5.1 | 6.6 | 29.4 |
| Dallas/Garland/Irving/ Plano, TX* | 8.3 | 8.0 | –3.6 | San Jose, CA | 4.7 | 6.6 | 40.4 |
| Omaha, NE | 7.0 | 8.0 | 14.3 | Jersey City, NJ | 5.9 | 6.7 | 13.6 |
| New York/Yonkers, NY | 9.3 | 8.2 | –11.8 | Fort Worth/ Arlington, TX | 6.1 | 6.8 | 11.5 |
| Corpus Christi, TX | 6.3 | 8.2 | 30.2 | Phoenix/Mesa/ Glendale/ Scottsdale, AZ† | 5.7 | 6.8 | 19.3 |
| Tucson, AZ | 6.2 | 8.2 | 32.3 | Boston, MA | 5.4 | 6.8 | 25.9 |
| Norfolk/Virginia Beach/ Chesapeake, VA | 7.6 | 8.3 | 9.2 | El Paso, TX | 7.5 | 6.9 | –8.0 |
| Indianapolis, IN | 8.2 | 8.4 | 2.4 | Jacksonville, FL | 7.5 | 6.9 | –8.0 |
| Toledo, OH | 8.1 | 8.4 | 3.7 | Detroit, MI | 6.1 | 6.9 | 13.1 |

**TABLE 2.** ***Continued***

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Tulsa, OK | 6.7 | 8.4 | 25.4 | Cleveland, OH | 5.9 | 6.9 | 16.9 |
| Miami/Hialeah, FL | 8.9 | 8.7 | −2.2 | Cincinnati, OH | 5.6 | 6.9 | 23.2 |
| Oklahoma City, OK | 7.6 | 8.7 | 14.5 | Buffalo, NY | 4.9 | 6.9 | 40.8 |
| Kansas City, MO | 9.0 | 8.8 | −2.2 | Oklahoma City, OK | 6.4 | 7.0 | 9.4 |
| Colorado Springs, CO | 8.7 | 8.8 | 1.1 | Philadelphia, PA | 6.0 | 7.0 | 16.7 |
| Fort Wayne, IN | 7.3 | 8.8 | 20.5 | Dallas/Garland/ Irving/Plano, TX* | 5.8 | 7.0 | 20.7 |
| Grand Rapids, MI | 7.1 | 8.9 | 25.4 | Tampa/ St. Petersburg, FL | 6.6 | 7.1 | 7.6 |
| Tampa/ St. Petersburg, FL | 9.1 | 9.0 | −1.1 | New York/ Yonkers, NY | 5.9 | 7.1 | 20.3 |
| Boston, MA | 8.7 | 9.0 | 3.4 | Miami/Hialeah, FL | 5.9 | 7.1 | 20.3 |
| Denver/Aurora, CO | 9.8 | 9.1 | −7.1 | Columbus, OH | 5.9 | 7.1 | 20.3 |
| Charlotte, NC | 9.4 | 9.1 | −3.2 | Chicago, IL | 5.9 | 7.1 | 20.3 |
| Nashville, TN | 9.0 | 9.2 | 2.2 | Pittsburgh, PA | 6.6 | 7.2 | 9.1 |
| Akron, OH | 8.6 | 9.2 | 7.0 | Louisville, KY | 6.4 | 7.2 | 12.5 |
| Greensboro, NC | 8.3 | 9.2 | 10.8 | Tulsa, OK | 5.9 | 7.2 | 22.0 |
| Lubbock, TX | 8.0 | 9.2 | 15.0 | Las Vegas, NV | 8.8 | 7.3 | −17.0 |
| Raleigh, NC | 8.7 | 9.3 | 6.9 | Lexington, KY | 6.2 | 7.3 | 17.7 |
| Louisville, KY | 9.4 | 9.4 | 0.0 | Baltimore, MD | 6.2 | 7.3 | 17.7 |
| Jacksonville, FL | 8.2 | 9.5 | 15.9 | Honolulu, HI | 7.3 | 7.4 | 1.4 |
| Columbus, OH | 8.2 | 9.6 | 17.1 | Washington, DC | 6.4 | 7.5 | 17.2 |
| Chicago, IL | 10.5 | 9.7 | −7.6 | Newark, NJ | 7.1 | 7.7 | 8.5 |
| Cincinnati, OH | 10.1 | 10.1 | 0.0 | Atlanta, GA | 7.3 | 7.8 | 6.8 |
| Augusta, GA | 10.1 | 10.2 | 1.0 | St. Louis, MO | 6.6 | 7.9 | 19.7 |
| Milwaukee, WI | 9.9 | 10.2 | 3.0 | Nashville, TN | 6.5 | 7.9 | 21.5 |
| Pittsburgh, PA | 11.2 | 10.3 | −8.0 | Tucson, AZ | 6.1 | 7.9 | 29.5 |
| Mobile, AL | 8.7 | 10.4 | 19.5 | Albuquerque, NM | 7.4 | 8.0 | 8.1 |
| Jersey City, NJ | 10.5 | 10.5 | 0.0 | Raleigh, NC | 7.3 | 8.0 | 9.6 |
| Atlanta, GA | 12.5 | 10.6 | −15.2 | Lubbock, TX | 7.0 | 8.0 | 14.3 |
| Buffalo, NY | 9.2 | 10.7 | 16.3 | Richmond, VA | 7.3 | 8.1 | 11.0 |
| Rochester, NY | 8.8 | 10.7 | 21.6 | Charlotte, NC | 7.1 | 8.1 | 14.1 |
| Philadelphia, PA | 11.5 | 10.8 | −6.1 | Denver/Aurora, CO | 7.4 | 8.2 | 10.8 |
| Baton Rouge, LA | 10.8 | 10.9 | 0.9 | Memphis, TN | 7.1 | 8.2 | 15.5 |
| Montgomery, AL | 9.3 | 11.3 | 21.5 | Augusta, GA | 8.0 | 8.4 | 5.0 |
| Cleveland, OH | 12.0 | 11.4 | −5.0 | Birmingham, AL | 7.2 | 8.4 | 16.7 |
| St. Louis, MO | 11.4 | 11.6 | 1.8 | Greensboro, NC | 8.0 | 8.6 | 7.5 |
| Washington, DC | 15.1 | 11.9 | −21.2 | Baton Rouge, LA | 7.8 | 8.7 | 11.5 |
| Birmingham, AL | 11.3 | 12.3 | 8.8 | Montgomery, AL | 8.8 | 8.8 | 0.0 |
| Shreveport, LA | 9.7 | 12.5 | 28.9 | Norfolk/ Virginia Beach/ Chesapeake, VA | 8.3 | 9.0 | 8.4 |
| New Orleans, LA | 12.8 | 12.6 | −1.6 | New Orleans, LA | 7.8 | 9.2 | 17.9 |

**TABLE 2.** ***Continued***

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Richmond, VA | 12.7 | 12.8 | 0.8 | Colorado Springs, CO | 7.4 | 9.3 | 25.7 |
| Memphis, TN | 11.9 | 12.8 | 7.6 | Corpus Christi, TX | 6.8 | 9.4 | 38.2 |
| Newark, NJ | 12.7 | 13.3 | 4.7 | Shreveport, LA | 8.7 | 9.8 | 12.6 |
| Baltimore, MD | 12.6 | 13.5 | 7.1 | Mobile, AL | 7.3 | 10.1 | 38.4 |
| Detroit, MI | 14.0 | 13.8 | –1.4 | Anchorage, AK | NA | NA | NA |

*Source:* Tabulations based on data from the National Center for Health Statistics.

N/A, not applicable; Anchorage City, Alaska, and metropolitan statistical area boundaries are the same.

*Data for Plano, Texas, were excluded from city and suburban rates because they were unavailable for 1990.

†Data for Scottsdale and Glendale, Arizona, were excluded from city and suburban rates because they were unavailable for 1990.

racial/ethnic groups differed little between cities and suburbs. Non-Hispanic blacks in the 100 largest cities were the only group to experience a decrease (4%) in LBW rates between 1990 and 2000; suburban blacks showed no change in rates (Fig. 2). LBW rates for black infants, however, were nearly twice the rate of white infants in both cities and suburbs on average. The disparity between black and white LBW rates narrowed between 1990 and 2000, but this improvement was more because of the increase in white LBW rates than to the modest improvements among blacks. Public health experts have reached the same conclusion from national data.[9]

Suburban whites experienced the largest increase in LBW rates—17.4%—between 1990 and 2000. Urban white LBW rates increased about 12% during this period. This large increase, along with only modest increases in city and suburban Hispanic LBW rates (2.2% and 5.6%, respectively), led to Hispanic LBW rates that were on par with white rates in both cities and suburbs on average. City and suburban Asians also experienced a relatively high increase in LBW rates (10%) from

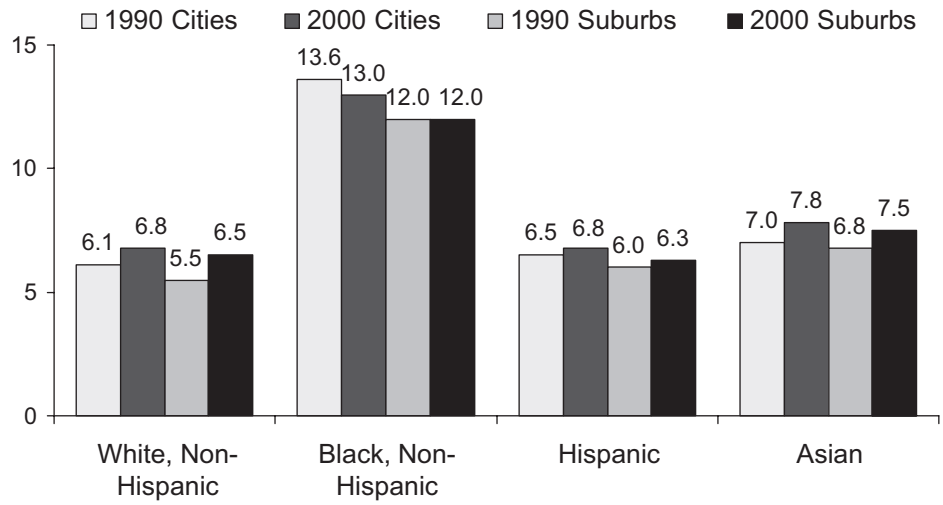


**FIGURE 2.** Percentage of live births of low birth weight by race/ethnicity.

1990 to 2000. Urban and suburban Asian LBW rates were higher than both white and Hispanic rates on average.

### Infant Mortality Trends in US Cities and Their Suburbs

As with LBW rates, the average urban IM rate in 1990 and 2000 was above the national average; the average suburban IM rate was below the national average (Fig. 3). By 2000, the cities as a group had not met the Healthy People 2000 goal of 7 infant deaths per 1,000 live births, although cities in the West on average did meet the target. The suburbs of the 100 largest cities, as a whole and within each region, also met the 2000 IM goal. Although cities overall missed the 2000 target, the IM rates for cities declined 23.4% on average, from 11.1 to 8.5 between 1990 and 2000, with a slightly smaller decline (20.5%), on average, occurring in the suburbs.

City IM rates differed considerably by region; suburban IM rates were much more similar across regions (Table 1). The Northeast had the largest gap in city and suburban IM rates, with city rates double suburban rates on average. In the Midwest as well, cities tended to have much higher rates on average than their suburbs. Over the 1990s, cities in the West averaged the largest decrease in IM rates (30.7%), such that by 2000, the average city rate was lower than the suburban rate (5.9 vs. 6.5). The suburbs of the Midwest made the least progress in reducing IM rates, with a decline of 14.8% between 1990 and 2000.

Table 3 presents 1990 and 2000 IM rates for the 100 largest cities and their suburbs, ranked by the lowest 2000 rate. Ten cities had achieved the Healthy People 2000 IM target by 1990, along with 29 suburbs. By 2000, 34 cities—more than triple the number in 1990—and 58 suburbs, or double the number in 1990, had achieved the 2000 IM goal. All but 9 of the 82 city cases examined had a decrease in their IM rate between 1990 and 2000, with all the increases occurring in the South or Midwest, except for Honolulu, Hawaii, and Rochester, New York. Eighteen suburban areas—twice the number of cities—had an increase in the

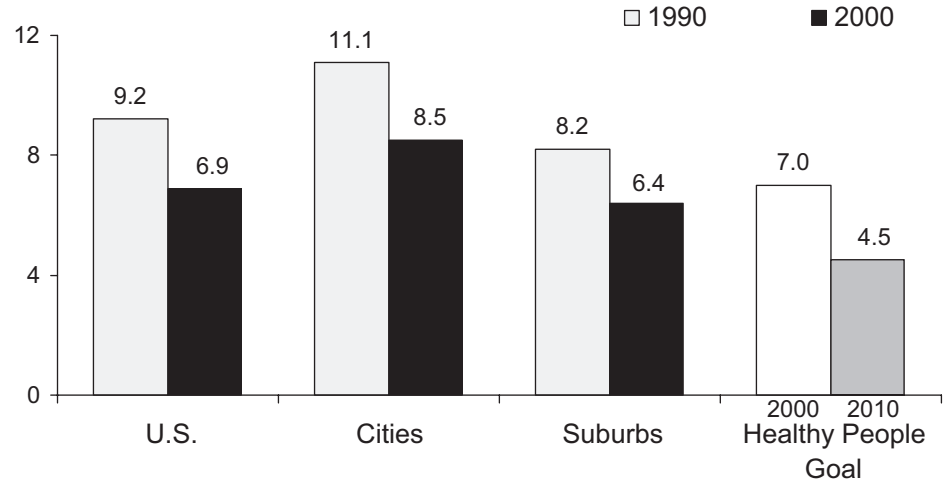


**FIGURE 3.** Infant mortality rates per 1,000 live births.

**TABLE 3. 1990 and 2000 infant mortality rates for the 100 largest cities and their suburbs ranked by lowest 2000 rate**

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Madison, WI | 7.3 | 3.8 | –48.7 | Corpus Christi, TX | 7.2 | 4.0 | –44.8 |
| Las Vegas, NV | 5.1 | 3.8 | –24.2 | San Jose, CA | 6.5 | 4.0 | –38.8 |
| Anchorage, AK | 8.8 | 3.9 | –55.8 | Lincoln, NE | 8.2 | 4.2 | –49.0 |
| San Francisco, CA | 7.2 | 4.0 | –43.9 | Portland, OR | 8.3 | 4.2 | –49.5 |
| El Paso, TX | 6.0 | 4.4 | –27.0 | Minneapolis/St. Paul, MN | 6.3 | 4.2 | –33.4 |
| *Healthy People 2010 infant mortality rate goal: 4.5* | | | | Albuquerque, NM | 8.5 | 4.3 | –49.9 |
| Seattle, WA | 8.1 | 4.6 | –43.2 | Baton Rouge, LA | 9.0 | 4.3 | –52.3 |
| Austin, TX | 6.4 | 4.6 | –28.2 | Seattle, WA | 6.1 | 4.4 | –28.7 |
| San Jose, CA | 4.8 | 4.8 | –0.9 | Boston, MA | 6.5 | 4.4 | –32.5 |
| San Antonio, TX | 6.8 | 4.9 | –27.7 | Spokane, WA | 7.0 | 4.4 | –36.9 |
| Spokane, WA | 6.4 | 5.0 | –22.6 | Nashville, TN | 7.5 | 4.4 | –40.9 |
| Los Angeles/Long Beach/Glendale, CA | 8.2 | 5.1 | –38.4 | Dallas/Garland/Irving/Plano, TX | 8.0 | 4.5 | –43.5 |
| Tacoma, WA | 9.4 | 5.1 | –45.9 | Oakland/Fremont, CA | 6.8 | 4.5 | –33.7 |
| Houston, TX | 9.3 | 5.1 | –44.5 | *Healthy People 2010 infant mortality rate goal: 4.5* | | | |
| Miami/Hialeah, FL | 6.2 | 5.2 | –16.5 | Austin, TX | 6.6 | 4.6 | –30.5 |
| Oakland/Fremont, CA | 10.3 | 5.3 | –48.8 | New York/Yonkers, NY | 7.0 | 4.6 | –33.9 |
| Dallas/Garland/Irving/Plano, TX | 8.9 | 5.4 | –39.3 | El Paso, TX | 6.1 | 4.6 | –23.5 |
| Santa Ana/Anaheim, CA | 9.2 | 5.5 | –40.1 | Santa Ana/Anaheim (Orange Co.), CA | 7.0 | 4.7 | –33.4 |
| Tucson, AZ | 7.1 | 5.5 | –22.7 | Los Angeles/Long Beach/Glendale, CA | 7.8 | 4.9 | –37.5 |
| Portland, OR | 8.3 | 5.9 | –29.2 | San Francisco, CA | 6.1 | 4.9 | –18.9 |
| Lincoln, NE | 7.3 | 6.0 | –18.8 | Houston, TX | 6.9 | 5.0 | –28.1 |
| Montgomery, AL | 10.8 | 6.4 | –40.5 | Sacramento, CA | 6.8 | 5.0 | –26.2 |
| Fort Worth/Arlington, TX | 10.3 | 6.4 | –37.8 | Milwaukee, WI | 5.7 | 5.1 | –10.6 |
| New York/Yonkers, NY | 11.5 | 6.4 | –44.0 | Jersey City, NJ | 8.5 | 5.1 | –39.7 |
| Fort Wayne, IN | 10.8 | 6.5 | –39.9 | Newark, NJ | 7.9 | 5.2 | –34.2 |
| Denver/Aurora, CO | 10.4 | 6.5 | –37.6 | Denver/Aurora, CO | 8.2 | 5.3 | –35.1 |
| Albuquerque, NM | 8.1 | 6.5 | –19.3 | Rochester, NY | 6.8 | 5.4 | –20.4 |
| San Diego, CA | 6.7 | 6.5 | –1.6 | San Diego, CA | 7.7 | 5.5 | –29.0 |

**TABLE 3.** ***Continued***

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Sacramento, CA | 10.3 | 6.6 | –35.9 | Toledo, OH | 7.8 | 5.6 | –29.0 |
| Boston, MA | 10.0 | 6.7 | –32.9 | Wichita, KS | 8.3 | 5.6 | –32.3 |
| Fresno, CA | 9.4 | 6.8 | –27.8 | Kansas City, MO | 8.0 | 5.6 | –29.6 |
| Tampa/St. Petersburg, FL | 10.8 | 6.9 | –36.4 | Washington, DC | 8.6 | 5.7 | –33.0 |
| Phoenix/Mesa/Glendale/Scottsdale, AZ | 9.3 | 6.9 | –25.7 | Akron, OH | 5.1 | 5.8 | 13.1 |
| New Orleans, LA | 16.5 | 7.0 | –57.6 | Philadelphia, PA | 7.9 | 5.8 | –26.7 |
| Louisville, KY | 10.8 | 7.0 | –35.1 | Fort Worth/Arlington, TX | 9.1 | 5.8 | –36.4 |
| *Healthy People 2000 infant mortality rate goal*: *7.0* | | | | Cincinnati, OH | 7.4 | 5.9 | –20.7 |
| Minneapolis/St. Paul, MN | 11.2 | 7.1 | –36.5 | San Antonio, TX | 8.1 | 6.0 | –25.3 |
| Honolulu, HI | 6.5 | 7.2 | 10.4 | Des Moines, IA | 4.3 | 6.1 | 40.9 |
| Kansas City, MO | 11.2 | 7.2 | –35.3 | Madison, WI | 5.7 | 6.1 | 6.2 |
| Stockton, CA | 10.0 | 7.3 | –26.3 | Phoenix/Mesa/Glendale/Scottsdale, AZ | 7.7 | 6.1 | –20.6 |
| Riverside, CA | 11.3 | 7.4 | –34.5 | Stockton, CA | 6.6 | 6.2 | –7.0 |
| Wichita, KS | 13.1 | 7.4 | –43.3 | Indianapolis, IN | 9.0 | 6.3 | –30.3 |
| Bakersfield, CA | 10.2 | 7.5 | –26.4 | Buffalo, NY | 5.1 | 6.3 | 24.3 |
| Colorado Springs, CO | 10.4 | 7.7 | –25.6 | Baltimore, MD | 6.3 | 6.3 | 0.6 |
| Atlanta, GA | 15.6 | 7.8 | –49.9 | Miami/Hialeah, FL | 15.9 | 6.3 | –60.2 |
| Corpus Christi, TX | 8.3 | 7.9 | –5.2 | Omaha, NE | 4.0 | 6.4 | 61.7 |
| Lubbock, TX | 9.1 | 8.1 | –10.3 | Columbus, OH | 8.2 | 6.4 | –21.1 |
| Raleigh, NC | 11.4 | 8.2 | –28.5 | Tulsa, OK | 6.8 | 6.4 | –5.1 |
| Toledo, OH | 9.7 | 8.3 | –14.7 | Detroit, MI | 7.9 | 6.5 | –17.9 |
| Des Moines, IA | 12.7 | 8.6 | –32.5 | Cleveland, OH | 9.4 | 6.6 | –29.4 |
| Greensboro, NC | 11.7 | 8.7 | –25.7 | Montgomery, AL | 13.8 | 6.7 | –51.7 |
| Norfolk/Virginia Beach/Chesapeake, VA | 13.6 | 8.7 | –36.0 | Riverside, CA | 9.1 | 6.8 | –25.5 |
| Charlotte, NC | 12.0 | 8.9 | –25.7 | Louisville, KY | 7.4 | 6.8 | –8.1 |
| Omaha, NE | 10.0 | 8.9 | –11.2 | Fort Wayne, IN | 5.1 | 6.8 | 33.5 |
| Jacksonville, FL | 12.1 | 9.3 | –23.4 | Raleigh, NC | 10.9 | 6.8 | –37.0 |
| Tulsa, OK | 9.5 | 9.6 | 1.1 | Richmond, VA | 9.6 | 6.9 | –28.4 |

**TABLE 3.** ***Continued***

| Cities | 1990 | 2000 | % Change | Suburbs | 1990 | 2000 | % Change |
|---|---|---|---|---|---|---|---|
| Lexington, KY | 4.9 | 9.7 | 96.5 | Tacoma, WA | 9.2 | 6.9 | –25.2 |
| Akron, OH | 11.5 | 9.9 | –13.9 | St. Louis, MO | 8.8 | 7.0 | –20.9 |
| Columbus, OH | 11.9 | 9.9 | –17.0 | New Orleans, LA | 7.4 | 7.0 | –5.1 |
| Indianapolis, IN | 12.4 | 9.9 | –20.1 | *Healthy People 2000 Infant Mortality Rate Goal*: *7.0* | | | |
| Nashville, TN | 9.4 | 10.2 | 9.0 | Chicago, IL | 8.7 | 7.1 | –18.0 |
| Buffalo, NY | 12.9 | 10.2 | –20.6 | Bakersfield, CA | 10.6 | 7.2 | –32.1 |
| Philadelphia, PA | 15.5 | 10.5 | –32.2 | Fresno, CA | 6.8 | 7.2 | 4.9 |
| Grand Rapids, MI | 11.4 | 10.7 | –6.4 | Atlanta, GA | 10.5 | 7.2 | –30.9 |
| Mobile, AL | 9.5 | 10.8 | 13.8 | Lexington, KY | 7.3 | 7.3 | 0.4 |
| Chicago, IL | 15.6 | 10.9 | –30.2 | Pittsburgh, PA | 7.8 | 7.3 | –6.2 |
| Baton Rouge, LA | 13.1 | 11.1 | –14.8 | Memphis, TN | 8.9 | 7.3 | –17.6 |
| Jersey City, NJ | 14.7 | 11.3 | –23.0 | Tampa/St. Petersburg, FL | 9.8 | 7.3 | –25.0 |
| Milwaukee, WI | 12.6 | 11.4 | –9.9 | Grand Rapids, MI | 6.6 | 7.4 | 12.1 |
| Baltimore, MD | 15.0 | 11.7 | –22.4 | Oklahoma City, OK | 9.5 | 7.4 | –22.9 |
| Washington, DC | 20.7 | 12.0 | –42.0 | Lubbock, TX | 7.1 | 7.5 | 5.0 |
| Pittsburgh, PA | 13.4 | 12.5 | –6.6 | Charlotte, NC | 10.1 | 8.4 | –17.5 |
| Oklahoma City, OK | 13.3 | 12.6 | –5.7 | Birmingham, AL | 8.6 | 8.4 | –2.4 |
| Augusta, GA | 15.7 | 12.6 | –19.6 | Jacksonville, FL | 7.8 | 8.6 | 9.7 |
| Richmond, VA | 16.5 | 12.8 | –22.7 | Mobile, AL | 10.4 | 8.8 | –15.5 |
| St. Louis, MO | 12.7 | 12.9 | 1.5 | Honolulu, HI | 6.8 | 9.0 | 32.3 |
| Cincinnati, OH | 14.8 | 12.9 | –12.5 | Norfolk/Virginia Beach/Chesapeake, VA | 14.9 | 9.2 | –37.7 |
| Cleveland, OH | 17.9 | 13.2 | –25.9 | Augusta, GA | 9.6 | 9.7 | 0.9 |
| Newark, NJ | 18.5 | 14.2 | –23.2 | Las Vegas, NV | 15.2 | 10.0 | –34.2 |
| Detroit, MI | 20.3 | 14.8 | –27.0 | Shreveport, LA | 9.6 | 10.2 | 6.5 |
| Shreveport, LA | 11.7 | 15.2 | 29.4 | Greensboro, NC | 10.1 | 10.7 | 5.8 |
| Rochester, NY | 13.7 | 15.4 | 12.6 | Colorado Springs, CO | 5.6 | 12.8 | 127.1 |
| Memphis, TN | 16.9 | 16.1 | –4.9 | Tucson, AZ | 11.0 | 15.2 | 38.1 |
| Birmingham, AL | 14.9 | 16.7 | 11.8 | Anchorage, AK | NA | NA | NA |

*Source*: Tabulations based on data from the National Center for Health Statistics.
N/A, not applicable; Anchorage City, Alaska, and metropolitan statistical area boundaries are the same.

IM rate. New Orleans, Louisiana, experienced the largest 1990 to 2000 decline in city IM rates (57.6%), and Miami/Hialeah, Florida, experienced the largest suburban area decline (60.2%).

### The Relationship Between Low Birth Weight and Infant Mortality

Although the LBW rate increased over the 1990s as the IM rate declined, we found that the rates for the two indicators are positively correlated. The 2000 city IM and LBW rates show a high Pearson correlation value of .807 ($P < .01$). The relationship is not as strong for suburban areas, but is still highly significant, with a correlation of .496 ($P < .01$). The slope of the trend line for cities is relatively steeper than that for the suburbs. Figures 4 and 5 show that, among cities, there is a wide range of LBW and IM rates that extends up the trend line. Among suburbs, the range of both LBW and IM rates is much tighter, and the IM rates start to flatten out, topping out at below 11 deaths per 1,000 live births, as the LBW rates extend beyond 7%. (Two infant mortality outliers, Tucson, AZ, and Colorado Springs, CO, were excluded from the suburban plot because they significantly shifted the trend line upward.) The same patterns held for 1990 data. We found the respective 1990 city and suburban slopes were virtually parallel with the 2000 trend lines, but shifted upward somewhat, reflecting the higher IM rates in 1990.

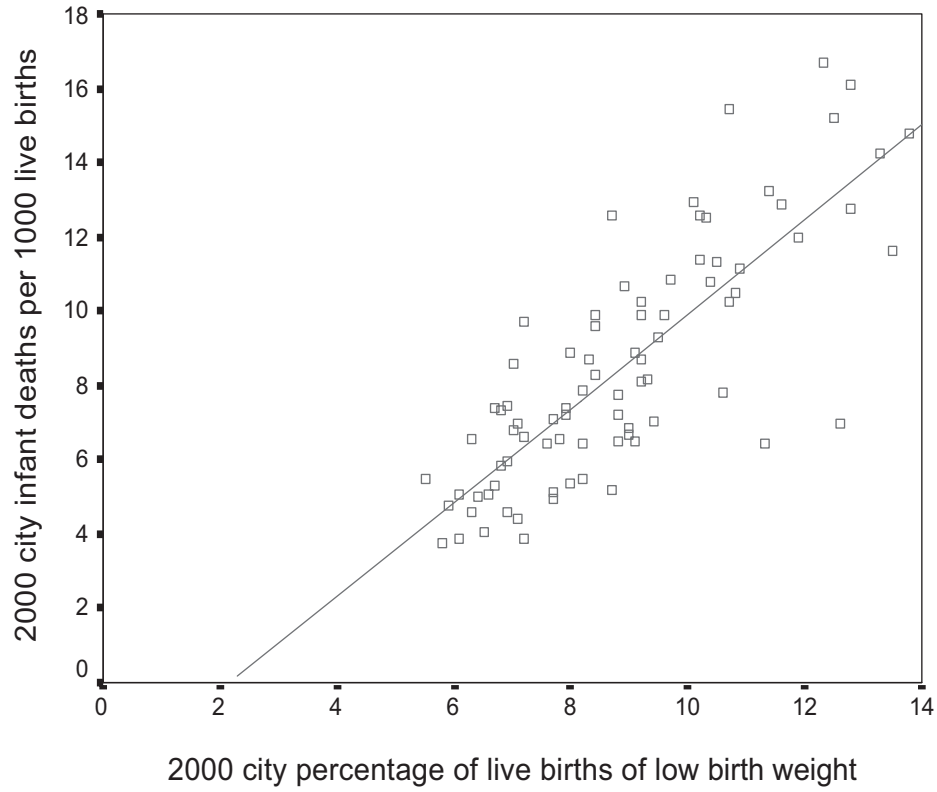


**FIGURE 4.** The 2000 low birth weight and infant mortality rates plotted for the 100 largest cities.

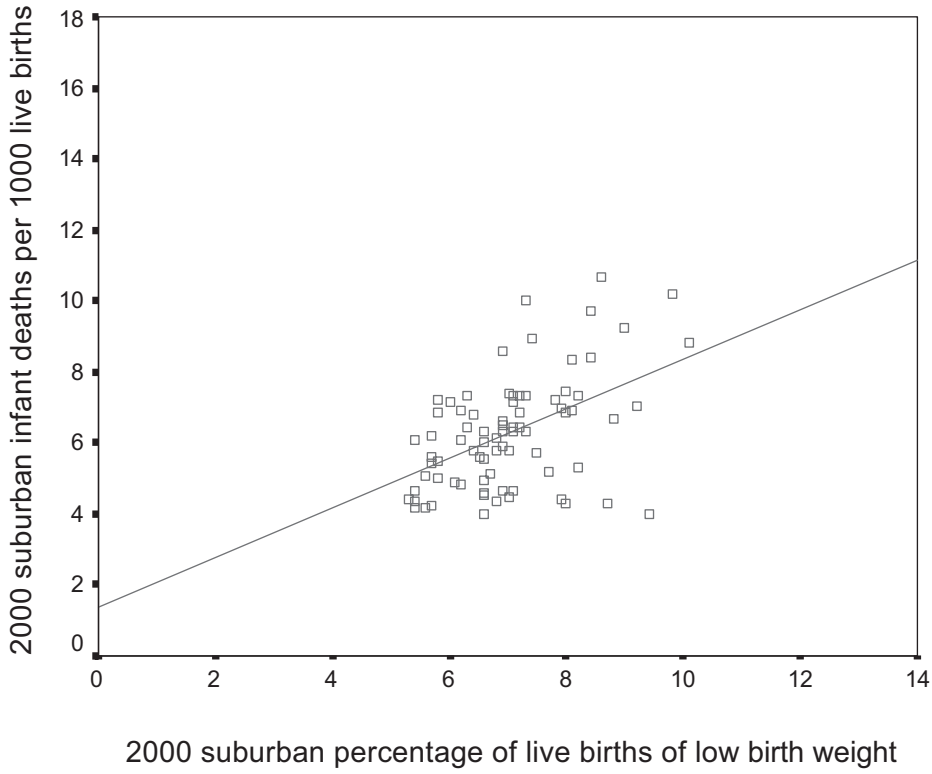


**FIGURE 5.** The 2000 low birth weight and infant mortality rates plotted for the suburbs of the 100 largest cities.

## DISCUSSION

Our analysis showed that, between 1990 and 2000, the 100 largest cities and their suburbs made progress toward meeting Healthy People IM rate targets, but moved away from the targets for LBW. Suburban LBW rates increased at a faster pace than the national and city rates, although the 2000 average remained well below the city and national averages. Suburban and city whites led the increases in LBW rates over this period; city and suburban blacks showed a slight decrease or no change in LBW rates. Nonetheless, urban and suburban black LBW rates remained about twice the rate for their white counterparts. These patterns, overall and by race/ethnicity, followed national trends for the same period.[9] Higher IM and LBW rates for blacks are not entirely explained by demographic risk factors, including lower education levels and incomes; other factors may include higher rates of stress, bacterial vaginosis, or other maternal conditions that may be unique to black women.[10]

Advancements in neonatal technologies that have improved the survival rates of preterm (32–36 weeks) and very preterm (under 32 weeks) babies have helped bring about the simultaneous reduction in neonatal mortality rates and increase in LBW infants.[1] However, national studies documented that preterm births, a leading cause of both IM and LBW, have steadily increased over the last two decades.[9] Reducing the incidence of preterm and very preterm births is thus an important component of meeting Healthy People goals for LBW and IM. Black women have nearly twice the risk of preterm delivery as white women.[10]

We found that differences in LBW and IM rates varied by region for cities and suburbs, as did the ratio of city-to-suburban rates. These variations strongly reflect differences in the racial/ethnic composition of these populations. On average, western cities had the lowest LBW and IM rates and the smallest ratios of city-to-suburban rates. Cities in the Northeast had the highest average LBW and IM rates and the largest ratios of city-to-suburban rates. In results reported elsewhere, we found that blacks comprised the smallest proportion of population of urban centers in the West (8% on average), with only one quarter to one third the percentage of the other regions.[11] The ratio of the percentage of city to suburban blacks was also lowest in the West—two to one—compared to five to one in the Northeast, where blacks comprise more than one third of the urban population on average.

The strong black–white differences in LBW and IM rates and significant differences in the composition of cities and suburbs by race suggest that the strategies needed to address LBW and IM must address these racial disparities. Cities with large black populations and suburbs with large white populations may need specific approaches that not only target their key population groups, but also meet the needs of other vulnerable populations.

Our plots of LBW and IM data for cities and suburbs suggest that the LBW rate may be relatively more independent of the IM rate in the suburbs compared to the cities. This may also be a reflection of the general differences in the racial composition of cities versus suburbs. Figures 4 and 5 may be showing that white LBW babies are more likely to survive than black LBW babies, perhaps because the average birth weight among white LBW babies is higher than that for black LBW babies. We were not able to measure the birth weight–specific survival of infants in cities and suburbs, however.

The more rapid rise over the 1990s in LBW rates in the suburbs, particularly among white infants, may be associated with recent fertility trends around older women who have delayed childbirth and the growing use of infertility treatments. Advanced maternal age is associated with an increased risk of a LBW outcome, as is the use of assisted reproductive technologies (ART).[1] ART procedures also increase the risk of multiple births, which are associated with lower birth weights. According to the CDC, increases in white LBW and very LBW births may be attributable, in part, to increases in multiple births resulting from ART.[9] LBW rates are also relatively higher for singleton infants conceived with ART.[12]

A related potential explanation for the apparent difference in the relationship between LBW and IM in the suburbs compared to the cities is that there may be a higher proportional concentration of white women over age 35 years having children (with and without the use of ART) in the suburbs compared to the cities. One question is whether suburban LBW babies are relatively less at risk for IM, perhaps related to factors such as higher rates of maternal educational attainment and income and better access to pre-, peri-, and postnatal care.

In any case, the substantial increase of LBW neonates in suburban areas places greater importance on access to high-quality care in a neonatal intensive care unit across the broader metropolitan region. Anecdotal evidence suggests that the availability of neonatal intensive care unit beds is expanding in some suburban areas in response to a rise in LBW infants.[13] Community education in suburban areas and cities with large white populations may need to increase its focus on efforts to educate women on the relative risks of delayed childbearing and multiple births.

A number of urban communities that have not reached the targets for IM and LBW nonetheless made notable progress; Atlanta, Georgia, and Washington, D.C.,

are examples. These may be areas where targeted community health efforts, along with improvements in economic conditions, made a difference. Further exploration of "improvement" stories in select cities and suburbs could be helpful to other communities, but is beyond the scope of this study. That the overall urban LBW rate increased only modestly compared to the suburbs and that IM rates dropped slightly more in the cities than in the suburbs could be a sign that some of the traditional strategies for addressing LBW, such as smoking cessation and earlier access to prenatal care, have made a difference in the central cities and should be continued. Nationally, we know that between 1990 and 2000 fewer women smoked during their pregnancy.[14] Data we reported on elsewhere showed that cities, overall, made a larger improvement than suburbs in the rate of pregnant women obtaining prenatal care in the first trimester, with urban black women making the strongest gains.[11] Despite these successes, concerns remain about the level and fragility of progress. The most recent data[15] showed that the national IM rate rose slightly in 2002 over 2001.

One potential limitation of this study is the use of a single year rather than 3-year averages for the two points in time we studied because rates are subject to variability across years due to the relatively small number of outcomes. We note that, nationally, IM rates declined somewhat between 1989 and 1991, from 9.8 to 8.9, but were quite stable from 1999 to 2001; LBW rates were virtually unchanged in the same two 3-year periods.[15] The city and suburban trends we report for 1990 and 2000 reflect the national trends for the same 10-year period. We do not believe that our overall results or conclusions would change had we reported statistics based on 3-year averages. However, the rates and percentage changes reported for individual cities and suburbs, particularly the smallest, may be more subject to year-to-year variability. Using 3-year averages may have slightly shifted which cities we reported as meeting or not meeting Healthy People goals for those with rates near a target rate.

The results we report are based on a methodology that selected the 100 largest cities and then defined the suburban area as the portion of the city's metropolitan area net of its central cities. A methodology that selects the 100 largest metropolitan areas first and then subtracts the central cities to define suburban areas would have produced a somewhat different set of cities/suburbs, with the differences greatest among the smallest 20 areas. Compared to this method, our method somewhat underrepresents smaller cities in the Northeast with relatively large MSAs and overrepresents large cities in the other regions with relatively small MSAs. To the extent that these smaller cities in the Northeast have relatively high ratios of city-to-suburban rates, as do the other areas in the Northeast included in our study, our results may somewhat understate city-to-suburban differences compared to this alternative method.

## CONCLUSIONS

Although the national LBW rate has been steady over the last few years, it seems likely that most of the 100 largest cities and suburbs will not meet the Healthy People 2010 LBW goal without a substantial reduction in rates of preterm deliveries. A number of suburbs and a few cities in the Midwest and West that are relatively close to the LBW target will likely need to address increases in white LBW rates to achieve this Healthy People goal by 2010. A number of suburbs and a handful of cities—generally places with small black populations—had met the Healthy People 2010 IM rate target of 4.5 by 2000, and more cities and suburbs are likely to meet the target

by 2010 if the trend over the 1990s continues. Despite this significant progress, many large cities and suburbs—particularly those that did not meet the 2000 target—may be challenged to meet the 2010 goal for IM unless rates of preterm births are reduced. This issue is especially critical for urban centers with large black populations because preterm delivery is the leading cause of death for black infants.[10]

Our findings suggest the need to pursue or reinforce at least two different health care strategies in improving LBW rates. In the suburbs and in cities where technology may be playing an increasing role in reproduction, the contribution of ART to the rise in LBW rates may call for education and service interventions to address the potential perinatal and postnatal consequences for these specific populations. At the same time, access to adequate nutrition, smoking cessation, and stress-reduction counseling for pregnant women may need to be improved, especially in the central cities, and among traditionally vulnerable populations in the suburbs. Progress at the local level is essential to meeting our national Healthy People goals for LBW and IM.

## ACKNOWLEDGEMENT

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